Remarks

Claims 1-58 are pending, of which claims 22-58 have been withdrawn from consideration, and claims 1-21 have been rejected. Applicants have amended claim 1 and added claims 59-64 without introducing any new matter, and respectfully request the allowance of claims 1-21 and 59-64.

Claim Rejections under 35 U.S.C. § 103

Claims 1-5 and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243). Applicants have amended claim 1 and respectfully submit that claims 1-5 and 7 are allowable.

The present application relates to an Interface-Engineered Josephson Junction ("IEJ"), in which the barrier layer is formed by modifying a surface layer of a superconductor electrode, rather than depositing a non-superconducting layer on the electrode. Claim 1 includes, among other things, the features that the barrier between the superconducting electrodes comprises "a non-superconducting, ion-modified surface layer of the first superconductive oxide" and that the counterelectrode is epitaxial to the barrier. Both *Harada* and *Chan* fail to disclose or suggest these features.

Applicants had distinguished the claimed invention from *Harada* in view of *Chan* in several responses to Office Actions in U.S. Patent Application Serial Number 09/082,486 (the "'486 application), which is a parent application to the present application. The responses include: (1) Response filed on July 13, 2001, in response to the Office Action mailed on March 13, 2001; Response filed on December 11, 2001 (entered with the Request for Continued Examination filed on March 8, 2002), in response to the Final Rejection mailed on October 11, 2001; and (3) Response filed on January 2, 2003, in response to the Office Action mailed July 2, 2002. For brevity, Applicants will not restate those arguments here in their entirety, but instead incorporate those arguments herein by reference and highlight the following: Neither *Harada* nor *Chan* discloses or suggests a barrier that is an ion-modified layer of superconductive oxide electrode. In fact, instead of forming a non-superconducting barrier by ion-

modification of the superconductive electrode, the purpose of the plasma processing in *Harada* is to remove contaminants and other nonsuperconducting phase. *See,* page L1388. Any epitaxial relationship between the electrode and counterelectrode in the structure disclosed in *Harada* is due to the fact that they were both grown on the same single crystalline MgO substrate. *See,* page L1388.

Applicants further submit herewith the Declaration of John M. Rowell under 37 C.F.R. 1.132. Professor Rowell is an expert in the relevant technology. As the National Academy of Science notes in its citation, Prof. Rowell "is known for his contributions to the basic understanding and applications of superconductivity: the first observation of the Josephson effect; the quantitative verification of the electron-phonon interaction as the mechanism responsible for conventional superconductivity; and the translation of these accomplishments to applications of both low and high Tc superconductors." (*See,* National Academy of Science Member Directory, accessible at http://www.nasonline.org/site/Dir/1959908160?pg=vprof&mbr=1004919&returl=http%3A%2F%2Fwww.nasonline.org%2Fsite%2FDir%2F1959908160%3Fpg%3Dsrch%26view%3Dbasic&retmk=search_again_link.)

As Prof. Rowell notes in his Declaration, it is not clear from *Harada* that a barrier made of an ion-modified surface layer of a high-T_c superconductor was produced. The conclusion is due at least to (a) poor Josephson junction reported by *Harada,* (b) the ambiguous statements made in *Harada* regarding the plasma treatment, and (c) *Harada*'s report of using the lift-off technique to expose the surface to be treated by plasma. Furthermore, simply experimenting with the process reported by *Harada* paper would not have lead to the Josephson junction disclosed and claimed in the present application.

Furthermore, regarding *Chan,* it only discloses a ***deposited*** barrier. *See, e.g.,* col. 8, lines 3-11 of *Chan*. *Chan* therefore teaches away from the claimed invention and cannot be properly combined with *Harada.*

The cited references therefore do not render obvious claims 1-5 and 7.

The non-obviousness the claims are further demonstrated by the fact that the invention disclosed and claimed in the present application is widely recognized as being the first successful IEJ. The embodiments of the invention disclosed in the present application is also described in the publication, B.H. Moeckly and K. Char, "Properties of

interface-engineered high T_c Josephson junctions", *Appl. Phys. Lett.* 71(17), pp., 2526-2528 (1997) (the "Moeckly/Char paper"). To date, over 160 papers, over 150 of which by authors other than either of the Applicants, have cited the Moeckly/Char paper. Several of those papers are attached herewith as examples of statements people have made about the Moeckly/Char paper. The attached papers include:

1. T. Satoh, *et al.*, "Effect of lanthanum doping of YBaCuO electrode's on the characteristics of modified-interface edge junctions", *IEEE Transactions On Applied Superconductivity,* 13(2) pp. 791-793 (2003) ("Interface modification has been investigated as a process for fabricating highly uniform barriers, instead of barrier deposition or growth, for high-temperature superconducting (HTS) Josephson junctions. Moeckly and Char [1] were the first to demonstrate a reliable fabrication process for such junctions." (citing the Moeckly/Char paper.))

2. J. Yoshida, *et al.*, "Interfacce-Engineered Junctions with HbBACuO as the Counter-Electrode", *IEEE Transactions On Applied Superconductivity,* 13(2) pp. 599-602 (2003) ("Interface-engineered junctions (IEJs) are regarded as the most promising candidates for high-T_c digital circuit applications as they are superior to other high-T_c Josephson junctions in terms of uniformity and reproducibility [1]-[3]." (citing the Moeckly/Char paper and two other papers published later than the effective filing date of the present application.)

3. J. Yoshida, *et al.*, "Current transport in interface-engineered high-T_c Josephson junctions", *Physica C,* 367, pp. 260-266 (2002) ("The basic concept of an IEJ is to create a this barrier layer by altering the structure or chemistry of the base-electrode layer only at the surfaces [1]" (citing the Moeckly/Char paper.))

4. H. Katsuno, *et al.*, "Characteristics of interface-engineered Josephson junctions using a $YbBa_2Cu_3O_y$ counterelectrode layer", *Appl. Phys. Lett.*, 79(25), pp. 4189-4191 (2001) ("The interface-engineering technique proposed by Moeckly and Char[1] is regarded as the most promising method for fabricating high-temperature superconductor Josephson junctions for digital circuit application because of the resultant high uniformity in junction characteristics." (citing the Moeckly/Char paper.))

5. J. Kye, *et al.*, "Interface-modified YBCO ramp-edge Josephson junctions by deionized water", *Supercond. Sci. Technol.*, 14, pp. 1056-1059 (2001) ("Several years ago Moeckly and Char fabricated interface-modified ramp-edge type HTSC JJ without depositing any artificial barrier [1]" (citing the Moeckly/Char paper.))

6. Tinchev, *et al.* "Interface-engineered' high-T-c Josephson junctions: a possible mechanism of operation", *Supercond. Sci. Technol.*, 12, pp. L5-L7 (1999) ("Ramp-type Josephson junctions fabricated without any deposited interlayer

and in which the barrier is created by an interface modification have attracted great attention recently [1-4]." (citing the Moeckly/Char paper and three other papers published later than the effective filing date of the present application.))

7. Y. Wu, *et al.*, "Structural variation of the interface-engineered layers in $YBa_2Cu_3O_{7-\delta}$ thin films", *Physica C,* 366, pp. 51-56 (2002) ("Recently, Moeckly et al. have developed an interface-engineered junction (IEJ), in which no barrier deposition is involved [5, 6]." (citing the Moeckly/Char paper and another paper by Moeckly and Char and published later than the effective filing date of the present application.))

8. J. K. Heinsohn *et al.*, "Current transport in ramp-type junctions with engineered interface", *J. Appl. Phys.*, 89(7), pp. 3852-3860 (2001) ("The idea of fabricating a barrier by interface treatments instead of using an epitaxially grown nonsuperconducting thin film was first suggested by Moeckly *et al.*[1]" (citing the Moeckly/Char paper.))

9. J. Yoshida, "Recent progress of high-temperature superconductor Josephson junction technology for digital circuit applications", *IEICE Trans. Electron.*, E83-C(1), pp. 49-59 (2000) ("A completely new approach to create an artificial barrier layer in ramp-edge-type junctions without the deposition of any barrier materials has recently been demonstrated by Moeckly and Char [10]." (citing the Moeckly/Char paper.))

10. J. G. Wen, *et al.*, "Atomic structure and composition of the barrier in the modified interface high-T_c Josephson junction studied by transmission electron microscopy", *Appl. Phys. Lett.*, 75(16), pp. 2470-2472 (1999) ("Recently, interface-engineered $YBa_2Cu_3O_y$ (YBCO) junctions (IEJ), developed by Moeckly *et al.*[1,2] attracted much attention since the reproducible and manufacturable process of fabrication is quite suitable for digital circuit applications." (citing the Moeckly/Char paper and another yet-unpublished paper.))

Claims 1-5 and 7 are therefore allowable over *Harada* and *Chan.*

Claims 6 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243), further in view of *Laibowitz* ("All high T_c edge junctions and SQUIDS"). Applicants respectfully traverse.

As discussed above, *Harada* in view of *Chan* does not render claim 1 obvious. *Laibowitz* does not supply what is missing in this regard. Therefore, the cited three references do not render claim 1 obvious, and therefore do not render claim 6 obvious.

Claims 8-12, 14-19 and 21 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243) and any of *Hunt (1993), Ishimaru (2002), Kito (2002) and the Moeckly/Char paper.* Applicants respectfully traverse.

First, Applicants respectfully notes that *Ishimaru, Kito* and the *Moeckly/Char paper* were published after the effective filing date of the present application with respect to the elected claims and therefore are not available as prior art references. Second, with respect to *Hunt,* as discussed above, *Harada* in view of *Chan* does not render claim 1 obvious. *Hunt* does not supply what is missing in this regard. Therefore, the cited three references do not render claim 1 obvious, and therefore do not render any of claims 8-12, 14-19 and 21 obvious.

It should be particularly pointed out that claims 8-21 had been deemed to contain allowable subject matter in the'486 application, which is a parent application to the present application (claims 8-21 are numbered 12-25, respectively, in the '486 application.) *See,* Office Actions mailed on July 2, 2002, and May 6, 2003 (the latter, while stating that claims 12-25 are rejected, does not set forth any ground for the rejection.) The Examiner cites *Hunt* and the three non-prior art references to support the disclosure of various I_cR_n product values. However, of the only reference available as prior art, *Hunt* discloses only a deposited barrier. *See,* the "Device Fabrication" section of *Hunt.* It therefore teaches away from the claimed invention and should not be combined with *Harada* and *Chan* as basis for claim rejection.

Claims 8-12, 14-19 and 21 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243) and *Satoh (2002).* Applicants respectfully traverse. Applicants respectfully notes that *Satoh* was published after the effective filing date of the present application with respect to the elected claims and therefore are not available as prior art references.

Claims 13 and 20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-

grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243) and *Laibowitz,* and further in view of any of *Hunt (1993), Ishimaru (2002), Kito (2002) and the Moeckly/Char paper.* Applicants respectfully traverse. As discussed above, *Harada, Chan and Laibowitz* fail to render claim 1 obvious. Further, *Ishimaru, Kito* and the *Moeckly/Char paper* were published after the effective filing date of the present application with respect to the elected claims and therefore are not available as prior art references. Further, *Hunt* teaches away from the claimed invention because it discloses a deposited barrier. Claims 13 and 20 are therefore not obvious over the cited references.

Further as noted above, claims 13 and 20 had been previously deemed to contain allowable subject matter in the parent '486 application and should be now allowed.

Claims 13 and 20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Harada* ("Fabrication of all-high-Tc Josephson junction using as-grown YBa2Cu3Ox thin films," *Jap. J. Appl. Phys., vol. 30*, pp. L1387-89 (1991)) in view of *Chan* (U.S. 5,892,243) and *Laibowitz,* and further in view of *Satoh (2002).* Applicants respectfully traverse. As discussed above, *Satoh* was published after the effective filing date of the present application with respect to the elected claims and therefore are not available as prior art references.

Applicants therefore respectfully request the allowance of claims 1-21.

New Claims

New claims 59-64 have been added. For at least the same reasons set forth above for the allowability of claims 1-21, Applicants respectfully request the allowance of claims 59-64.

SUMMARY

In view of the above amendments and remarks, Applicant respectfully requests a Notice of Allowance. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

23552
PATENT TRADEMARK OFFICE

Respectfully submitted,

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Date: April 28, 2008

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